Air Traffic Control Seminar

Current ATC Operations: Air Traffic Control Tower (ATCT)

Presented by Greg Kingery
San Francisco ATCT

NASA Ames Research Center

Moffett Field, California

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Air Traffic Control Tower Operations

The ATCT controls traffic on the airport movement areas and in the airspace immediately surrounding the airport. Their operation is intimately tied to those of Approach Controls and Centers.

Air Traffic Control Tower Operations

This presentation will include:

- **How ATCT interfaces with other air traffic facilities (TRACONS, ARTCC, etc.)**
- **Positions of operation in a typical tower.**
  - Basic responsibilities of each position.
  - Equipment used at each position.
- **Basic ATCT separation standards.**
- **SFO ATCT is shown in this presentation**
- **FEEL FREE TO ASK QUESTIONS!!**


ZAN
ZSE
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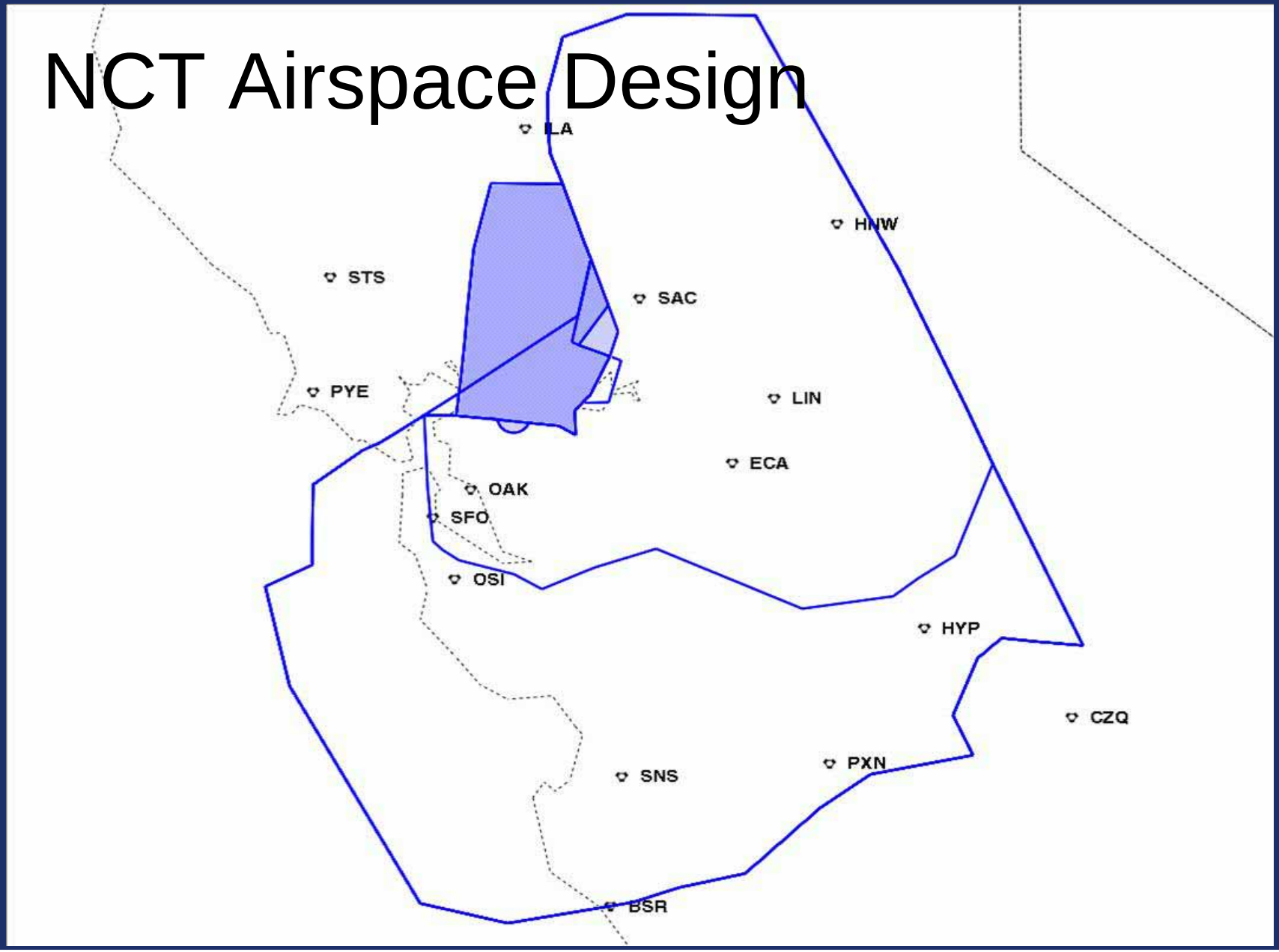
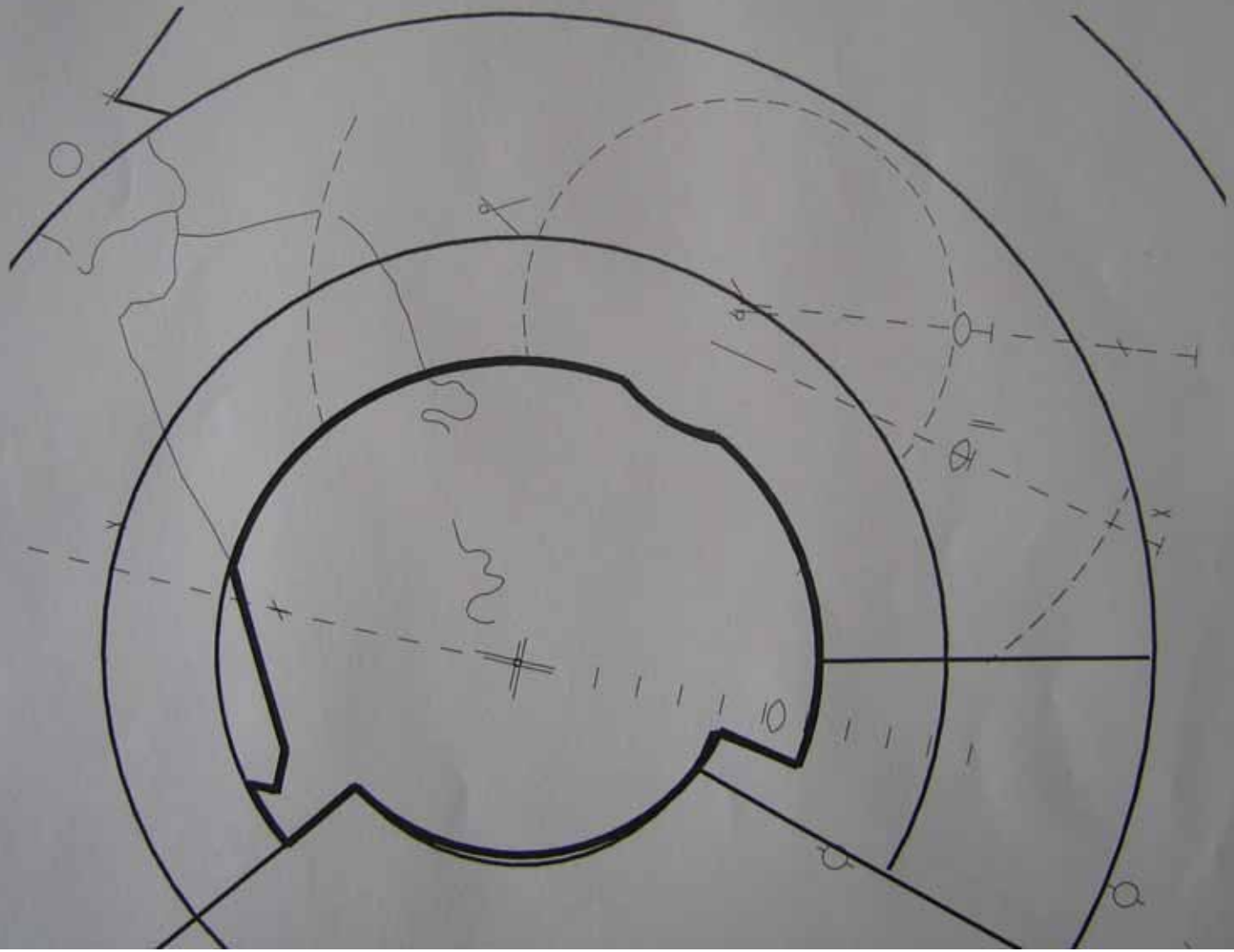
NCT Airspace Design



ATTACHMENT 7: SAN FRANCISCO TOWER'S DELEGATED AIRSPACE

AIRSPACE: The airspace within the San Francisco Class B Airspace Area "A" from the surface up to and including 2,000' MSL. From the hours of 2200-0700 local, San Francisco Tower releases the airspace from the SFO 342° radial clockwise to the SFO 075° radial above 700 feet to NCT.



ATCT Positions of Operation

- Flight Data/Clearance Delivery
- Ground Control
- Radar Coordinator (Local Assist)
- Local Control
- Cab Coordinator
- Traffic Management Coordinator
- Operations Supervisor

Flight Data/Clearance Delivery

BASIC RESPONSIBILITIES

Flight Data/Clearance Delivery

BASIC RESPONSIBILITIES

- **Know the SOP/LOA**
- **Use Tower Data Link Services (TDLS) to process necessary flight data. TDLS has 3 functions:**
  - Flight Data Input/Output (FDIO)
  - Pre-departure Clearance (PDC)
  - Digital Automated Terminal Information Service (D-ATIS)

Flight Data/Clearance Delivery

Flight Data Input/Output (FDIO)

- **Airline-filed flight plans are processed by the ARTCC Host computer and routed to the departure tower's FDIO.**
- **The FD/CD specialist receives a printed clearance 30 minutes prior to departure.**
- **The clearances will be issued to the pilot.**

Flight Data/Clearance Delivery

Pre-Departure Clearance (PDC)

- Clearances are issued from the ATCT directly to the cockpit via the ACARS (Aircraft Communications Addressing and Reporting System).
- No verbal communication required between pilot and Clearance Delivery.

Flight Data/Clearance Delivery

Responsibilities:

1. **Issue IFR clearances to outbound flights through the Pre-Departure Clearance (PDC) function.**

- **PDC Flight Plans**
  - Airline-filed flight plans are transmitted to ATCT via the FAA Air Route Traffic Control Center (ARTCC) Host computer

Flight Data/Clearance Delivery

Responsibilities:

- **PDC Work Station**
  - These clearances pop-up on the Pre-Departure Clearance (PDC) monitor and are printed as a Flight Progress Strip for use by other tower positions.
- **Clearance Delivery Specialist**
  - Via computer, adds local requirements such as initial altitude, departure frequencies and other relevant information; amends clearances as necessary, and sends clearance back to airline computer.

Flight Data/Clearance Delivery

Responsibilities:

- **Airline computer**
  - Delivers clearance to aircraft via Aircraft Communications Addressing and Reporting System (ACARS).

FDIO/PDC/D-ATIS Workstation

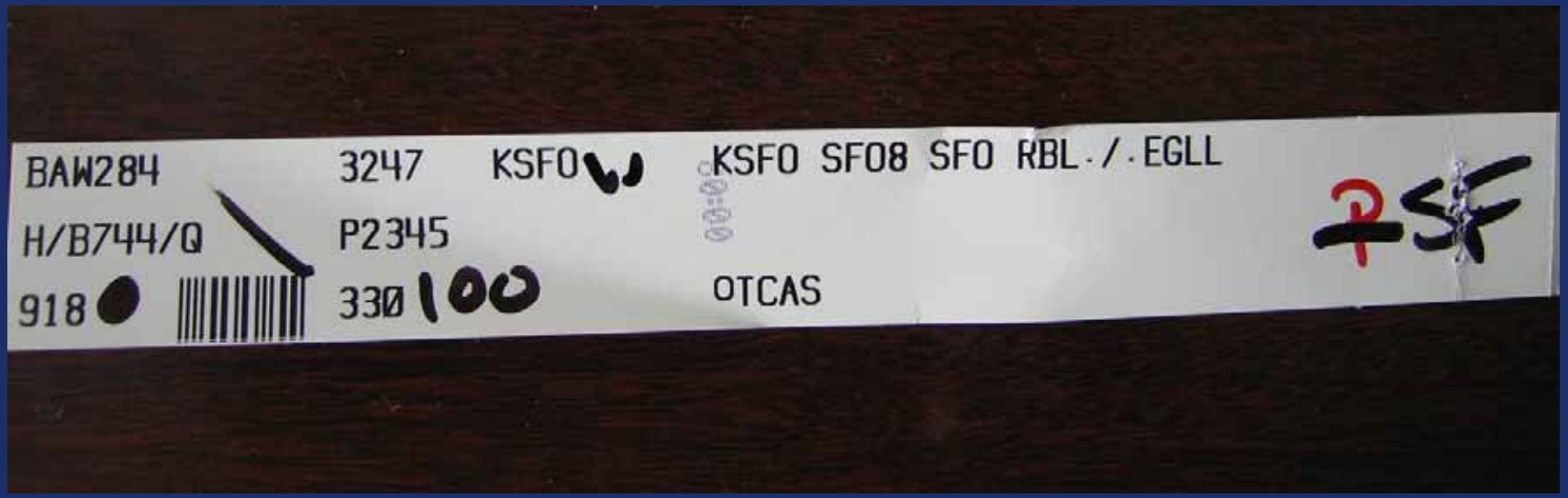
Flight Data/Clearance Delivery

Responsibilities:

2. **Read clearances verbally to pilots of aircraft unable to participate in the PDC program.**

- **Destination, departure procedure, route of flight, altitude and transponder code are normally issued. Other information issued as required.**
- **CD specialist must ensure pilot read backs are correct.**
- **After clearances are issued, flight progress strips are passed to the ground controller.**

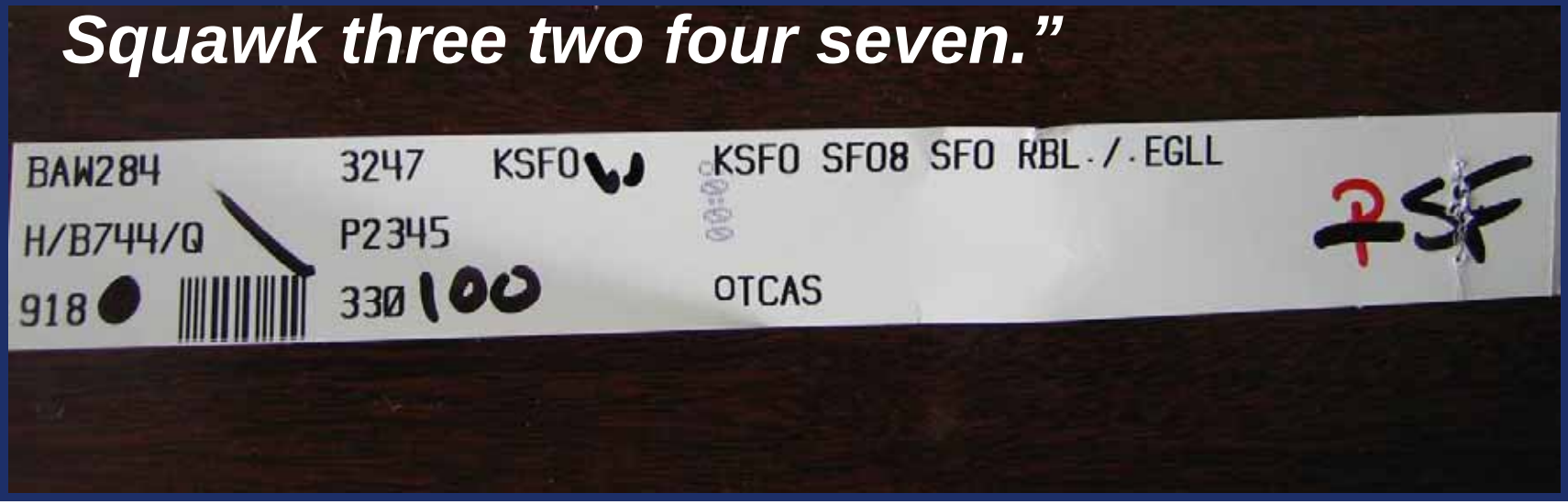
Example of Flight Progress Strip



Aircraft Identification	Beacon Code	Departure airport	Route of Flight			
BAW284	3247	KSFO	KSFO SFO8 SFO RBL./.EGLL			
Type Aircraft/ equipment suffix: H/B744/Q	Proposed departure time: P2345					
TCAS Equipped: o TCAS	Requested altitude: 330		Remarks			Local Tower Procedures
Computer Identification Number: 918						

Example of a verbally issued clearance

"Speedbird 284, cleared to Heathrow Airport via the San Francisco 8 Departure, vectors Red Bluff, then as filed. Maintain one-zero thousand, expect flight level three-three-zero one-zero minutes after departure. Squawk three two four seven."



Flight Data/Clearance Delivery

Responsibilities:

3. **Process and disseminate weather, traffic management and airport information.**

- **Relevant information put on D-ATIS recording which pilots receive in cockpit and/or telephone/computer:**

Flight Data/Clearance Delivery

Digital Automated Terminal Information Service (D-ATIS)

- **D-ATIS is a recorded message that plays continuously, informing pilots of critical ATC and airport data.**

Example D-ATIS Broadcast

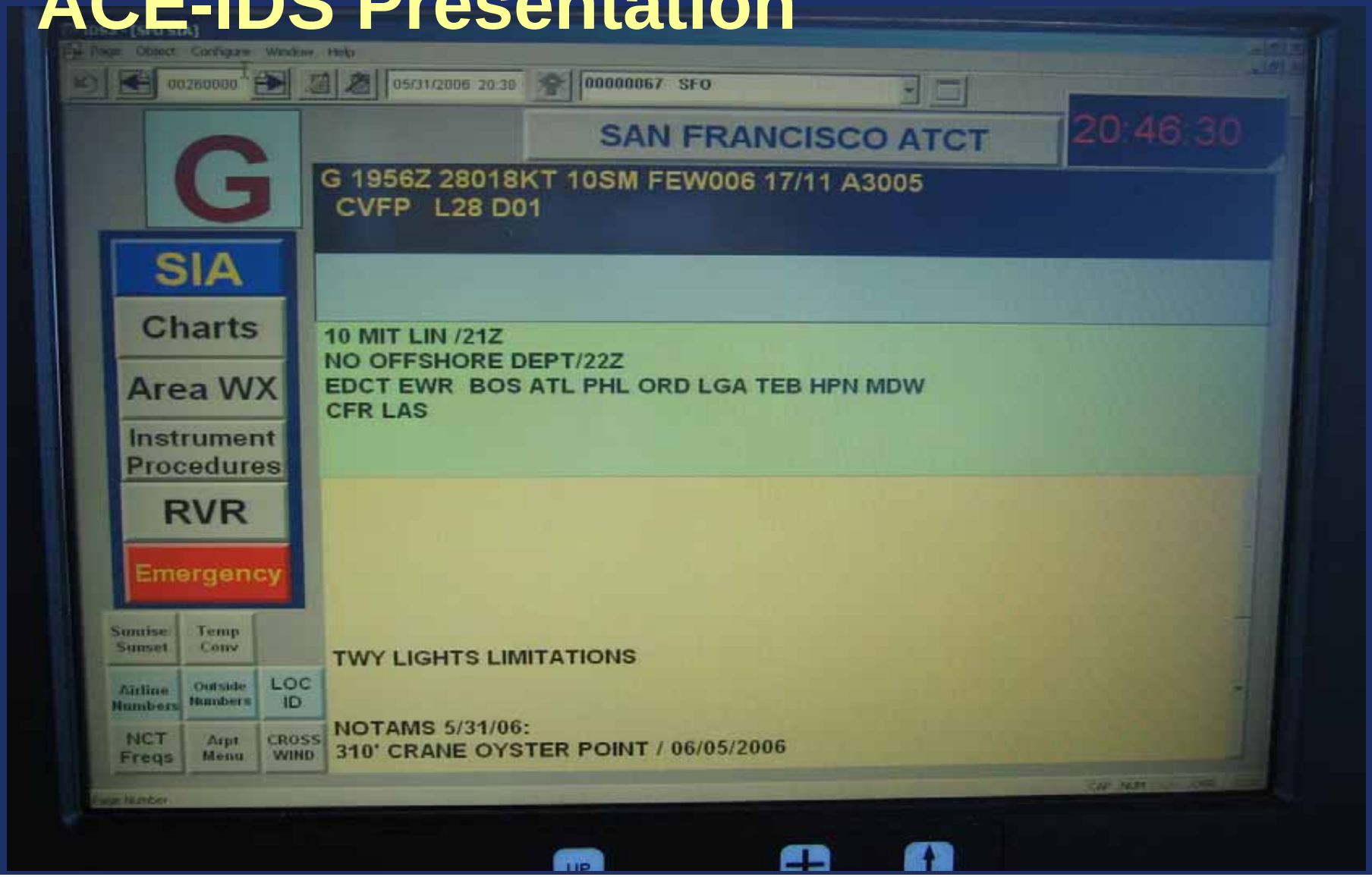
"SAN FRANCISCO INTERNATIONAL AIRPORT INFORMATION GOLF, 2156 ZULU, WIND TWO EIGHT ZERO AT ONE-ONE, VISIBILITY ONE ZERO, FEW CLOUDS AT ONE THOUSAND, TEMPERATURE ONE THREE, DEWPOINT NINER, ALTIMETER THREE ZERO ONE THREE. SIMULTANEOUS CHARTED VISUAL FLIGHT PROCEDURES IN EFFECT, ARRIVALS EXPECT RUNWAYS 28 LEFT, 28 RIGHT, DEPARTING RUNWAYS ONE LEFT, ONE RIGHT. READ BACK OF ALL RUNWAY HOLDING INSTRUCTIONS IS REQUIRED. ADVISE ON INITIAL CONTACT YOU HAVE INFORMATION GOLF."

Flight Data/Clearance Delivery

Responsibilities cont'd:

- **Disseminate appropriate information for use by SFO controllers and affected ATC facilities via the Automated Surface Observing System Controller's Equipment Information Display System (ACE-IDS).**
- **ACE-IDS information displays at Northern California TRACON sectors. Other Bay Area control towers are also on this system.**

ACE-IDS Presentation



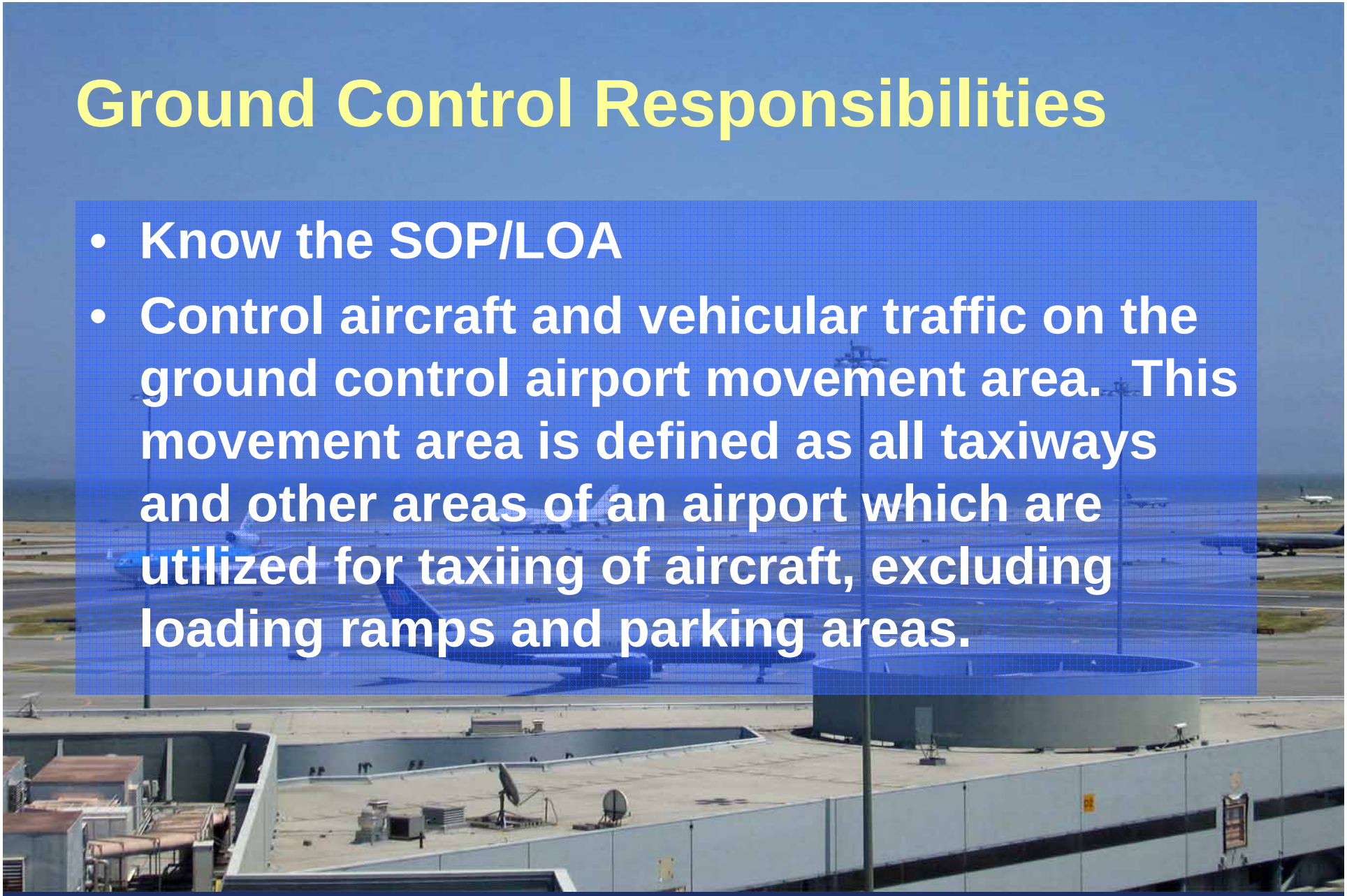
Flight Data/Clearance Delivery

Responsibilities cont'd:

4. Scans entire work area.

Ground Control

Ground Control Responsibilities



- **Know the SOP/LOA**
- **Control aircraft and vehicular traffic on the ground control airport movement area. This movement area is defined as all taxiways and other areas of an airport which are utilized for taxiing of aircraft, excluding loading ramps and parking areas.**

Ground Control Responsibilities

- **GC controls aircraft taxiing from parking areas to the active runways. GC issues the runway most advantageous for ATC, or the runway required due to weather, or requested by the pilot, if different from above. Issues detailed taxi instructions when necessary.**

  'UNITED 1494, TAXI TO RUNWAY ONE LEFT VIA TAXIWAYS ALPHA, FOXTROT 1 AND BRAVO".
- **GC controls aircraft exiting the runways after landing. Issues instructions as necessary to parking areas.**

  "DELTA 393, TAXI TO THE RAMP VIA TAXIWAYS BRAVO, ECHO, ALPHA".

Ground Control Responsibilities

- GC also controls aircraft repositioning from one part of the airport to another.

  "UNITED TUG 81, PROCEED VIA TAXIWAYS ALPHA, BRAVO 1, ZULU AND CHARLIE TO THE SUPER BAY".
- GC coordinates with the Local Control position to cross or use any portion of the active runways.

- GC scans entire work area.

Ground Control Responsibilities

GC uses the following equipment:

- **Remote ARTS Color Display (RACD) radar**
- **Airport Surface Detection Equipment (ASDE) with Airport Movement Area Safety System (AMASS)**
- **Rapid-Deployment Voice Switching (RDVS)**
- **Time stamp**

Remote ARTS Color Display System (RACD)

- Plan-view radar used for identification and separation of aircraft.
- Used for traffic advisories and safety alerts.
- Interface capability allows “handoff” transfer of aircraft identification and control to other ATC facilities, such as Northern California TRACON, Oakland Center, or local control towers.
- Each aircraft has its own data tag which follows the aircraft target across the radar scope.
- GC uses this radar to see which aircraft will arrive next, and formulate a plan based on that traffic.

Remote ARTS Color Display System (RACD)

RACD


UAL1077
028 14
UAL878
006 16 H
N4668G*
019 11V
UAL1152
034 22 F
010 V
003VV
N747EP*
013 09V
RIGHT

Airport Surface Detection Equipment (ASDE) with Airport Movement Area Safety System (AMASS)

ASDE

- Plan-view ground radar of runways and taxiways.
- Identification/position of aircraft when visual observation precluded due to weather.
- Used extensively to ascertain if aircraft are clear of runways
- Aircraft ID of arrivals transfers from RACD to ASDE.

Airport Surface Detection Equipment (ASDE)

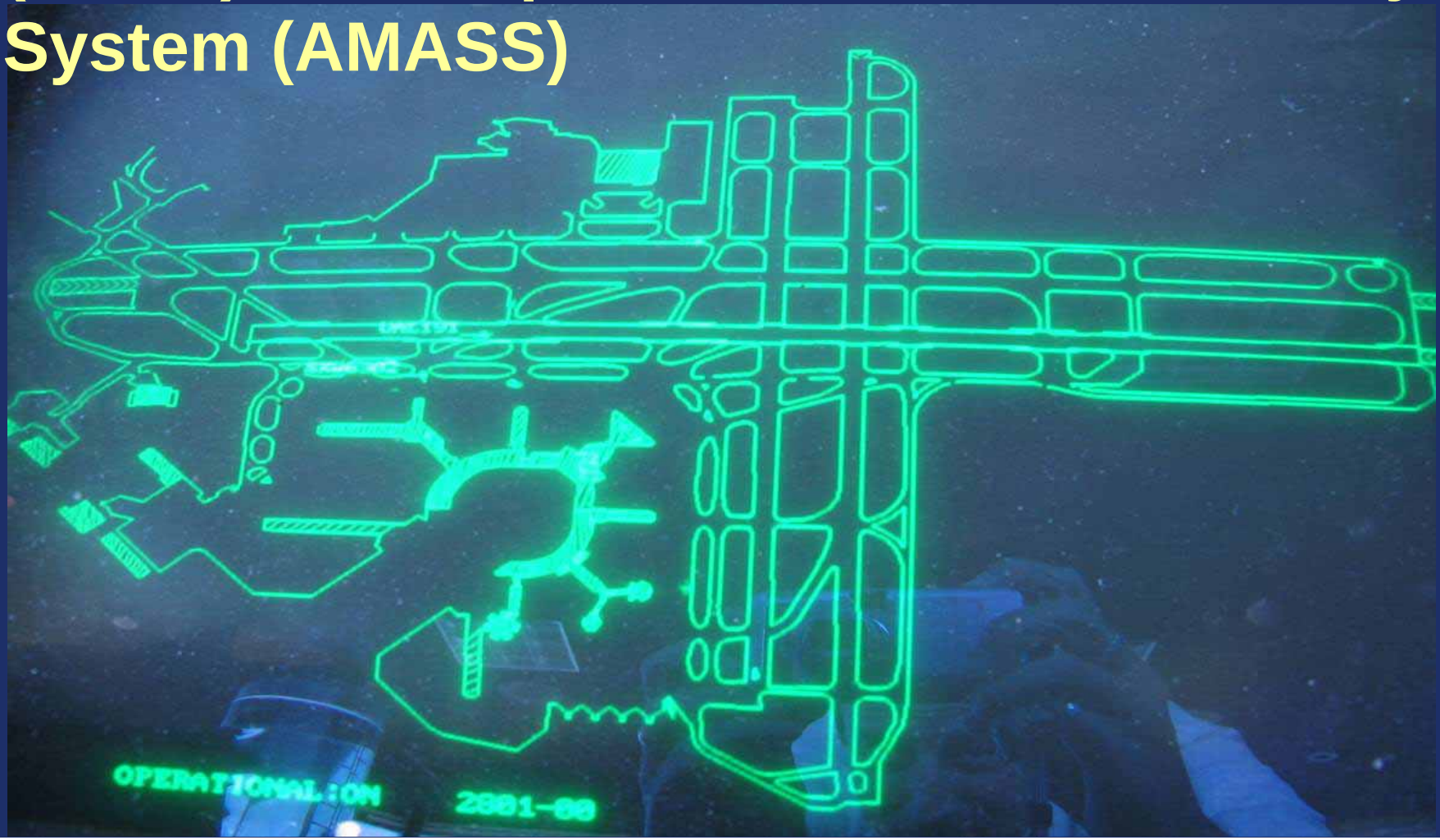
Airport Surface Detection Equipment (ASDE) with Airport Movement Area Safety System (AMASS)

AMASS

SFO AMASS provides aural and visual alarms for the following (other airport alarms will vary):

1. **Aircraft attempting to takeoff on an occupied runway.**
2. **Aircraft attempting to land on an occupied runway.**
3. **Aircraft attempting to land on a closed runway.**

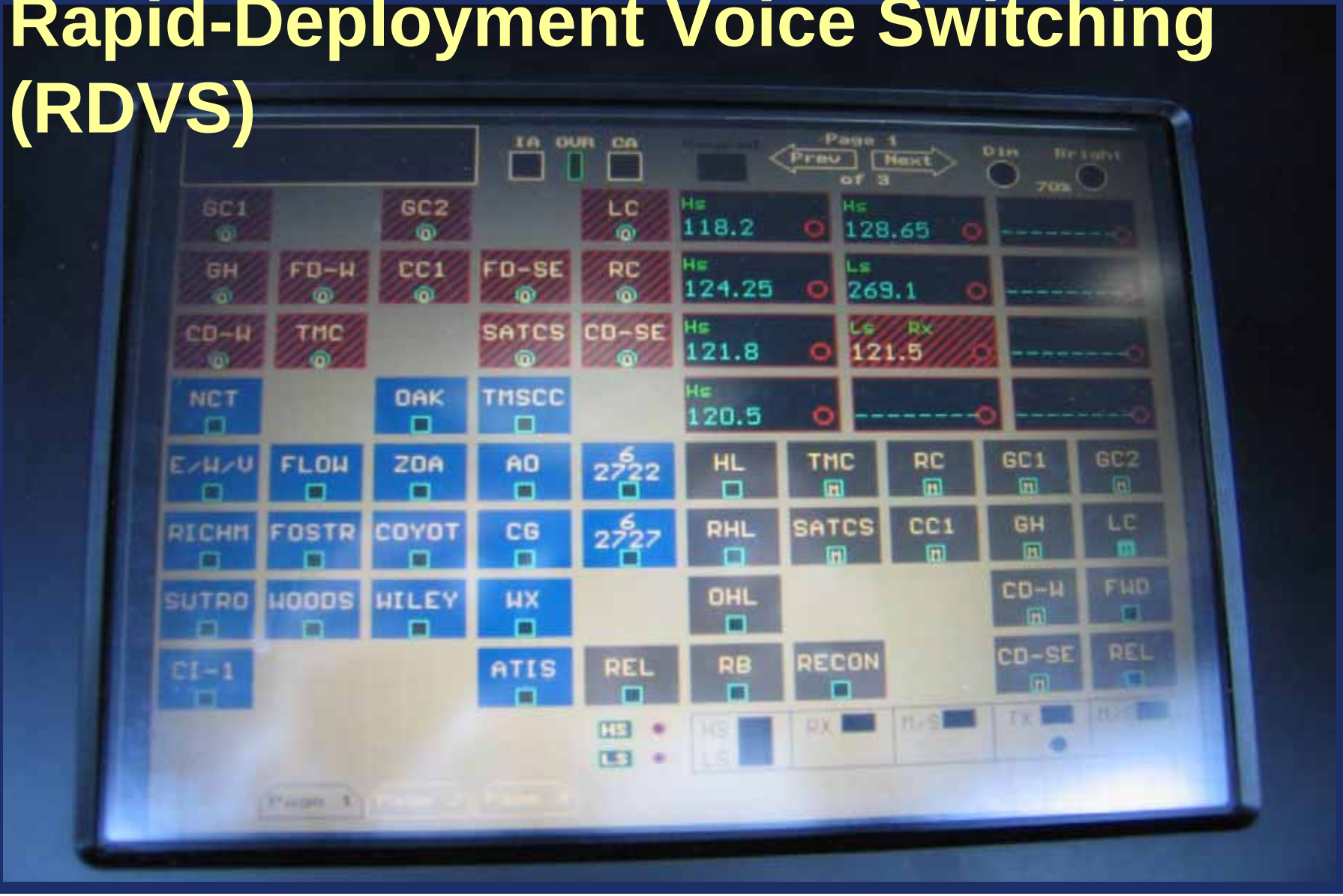
Airport Surface Detection Equipment (ASDE) with Airport Movement Area Safety System (AMASS)



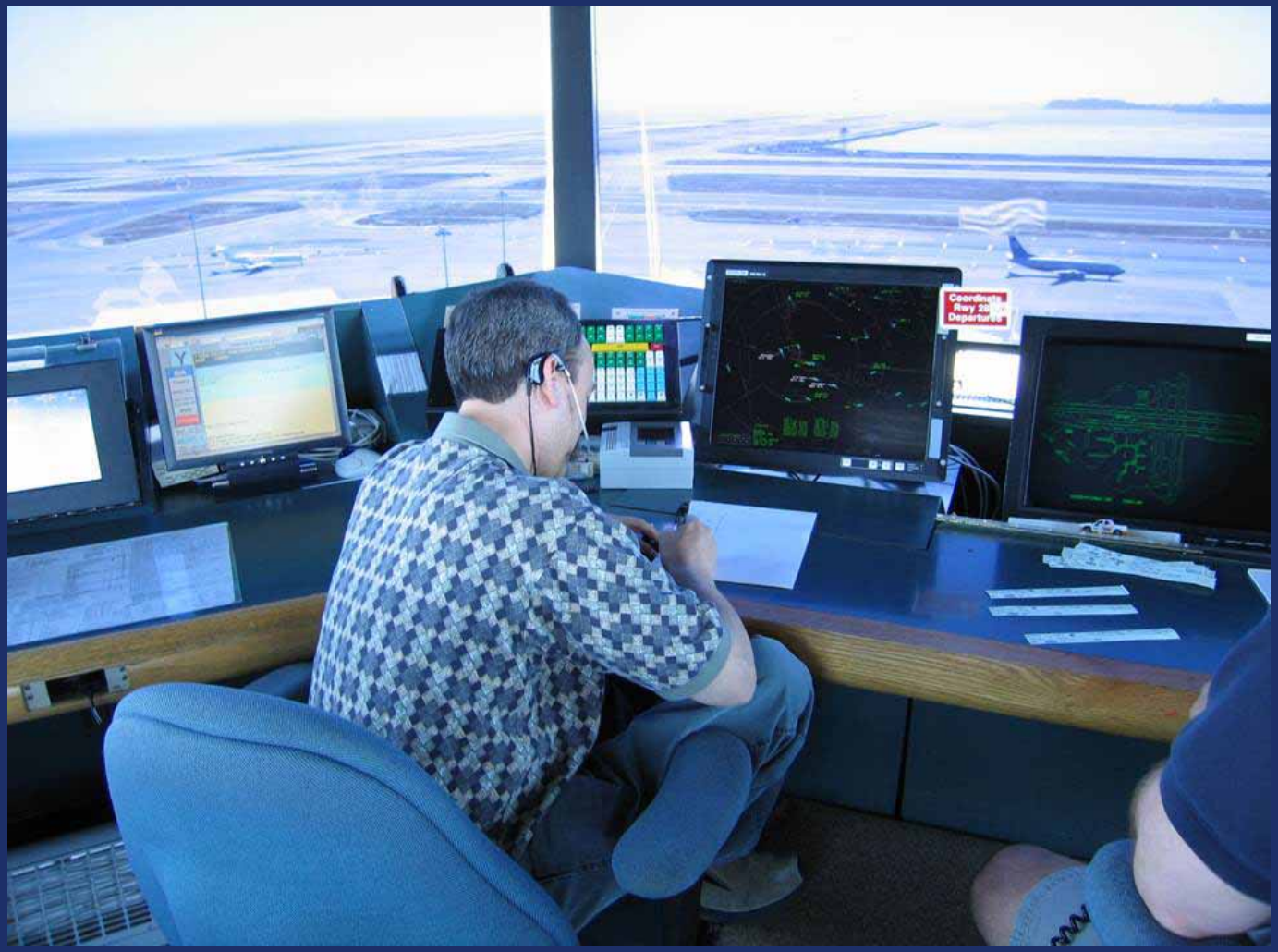
Rapid-Deployment Voice Switching (RDVS)

- Touch-screen communication system
- Used for inter and intra-facility communication
- Used to select radio frequencies and backup transmitters and receivers
- Used to monitor positions of operation

Rapid-Deployment Voice Switching (RDVS)



Radar Coordinator



Radar Coordinator

Basic Responsibilities

- **Know the SOP/LOA**
- **Monitor LC position**
- **Utilize Electronic Flight Strip Transmittal System (EFSTS) to alert Northern Calif. TRACON of impending departures.**
- **Perform inter-facility coordination required to assist Local Controller (landlines, handoffs).**
- **Keep written record of arrival and overflight operations.**
- **Scans the entire work area.**

Electronic Flight Strip Transmittal System (EFSTS)

- Each flight progress strip has a bar code which is passed over the scanner.
- Scanning a strip causes a duplicate strip to be printed out at the SFO departure sector at NCT.
- Coordination for some special operations, such as an aircraft departing from a runway not designated as active, can be accomplished with pre-scans.
- Information that cannot be passed through EFSTS must be verbally coordinated.

Electronic Flight Strip Transmittal System (EFSTS)

Local Control

Local Control

Responsibilities

1. **Know SOP/LOA**
2. **Separation of aircraft on the active runways.**
   - Same runway separation
   - Intersecting runway separation
   - Separation with GC traffic
3. **Scan entire work area**

Local Control

Responsibilities

Separation of aircraft in tower delegated airspace (6NM radius/2000ft)

- Initial separation of IFR departures
- Separation of IFR arrivals
- Separation of transitions

Local Control

Local Control uses the following equipment:

- **RACD**
- **ASDE/AMASS**
- **RDVS**
- **Low-Level Wind Shear Alert System (LLWAS)**
- **Runway Visual Range (RVR)**
- **Memory aids**
- **Time stamp**

Local Control

RACD

- LC uses RACD to identify and separate aircraft.
- LC uses RACD provide longitudinal, lateral and vertical separation.

RACD

RACD

RACD

Low-Level Wind Shear Alert System (LLWAS)

- Sensors located around airport
- Provides averaged “airport” wind
- Arrival and departure winds for various runways
- Wind shear and microburst alerts

Example: 28RA WSA 25K+ 1MF

Phraseology: *RUNWAY TWO EIGHT RIGHT ARRIVAL WIND SHEAR ALERT, TWO-FIVE KNOT GAIN, ONE-MILE FINAL*

Low-Level Wind Shear Alert System (LLWAS)

Runway Visual Range (RVR)

- **RVR equipment measures the visibility, in hundreds of feet, along the runway.**
- **RVR sensors are usually set up at touchdown, mid-runway and roll-out end of runway.**
- **Controllers use RVR readout in tower.**
- **RVR is issued to pilots when a reportable value (6000 ft. or less) is received or prevailing visibility is 1 mile or less.**

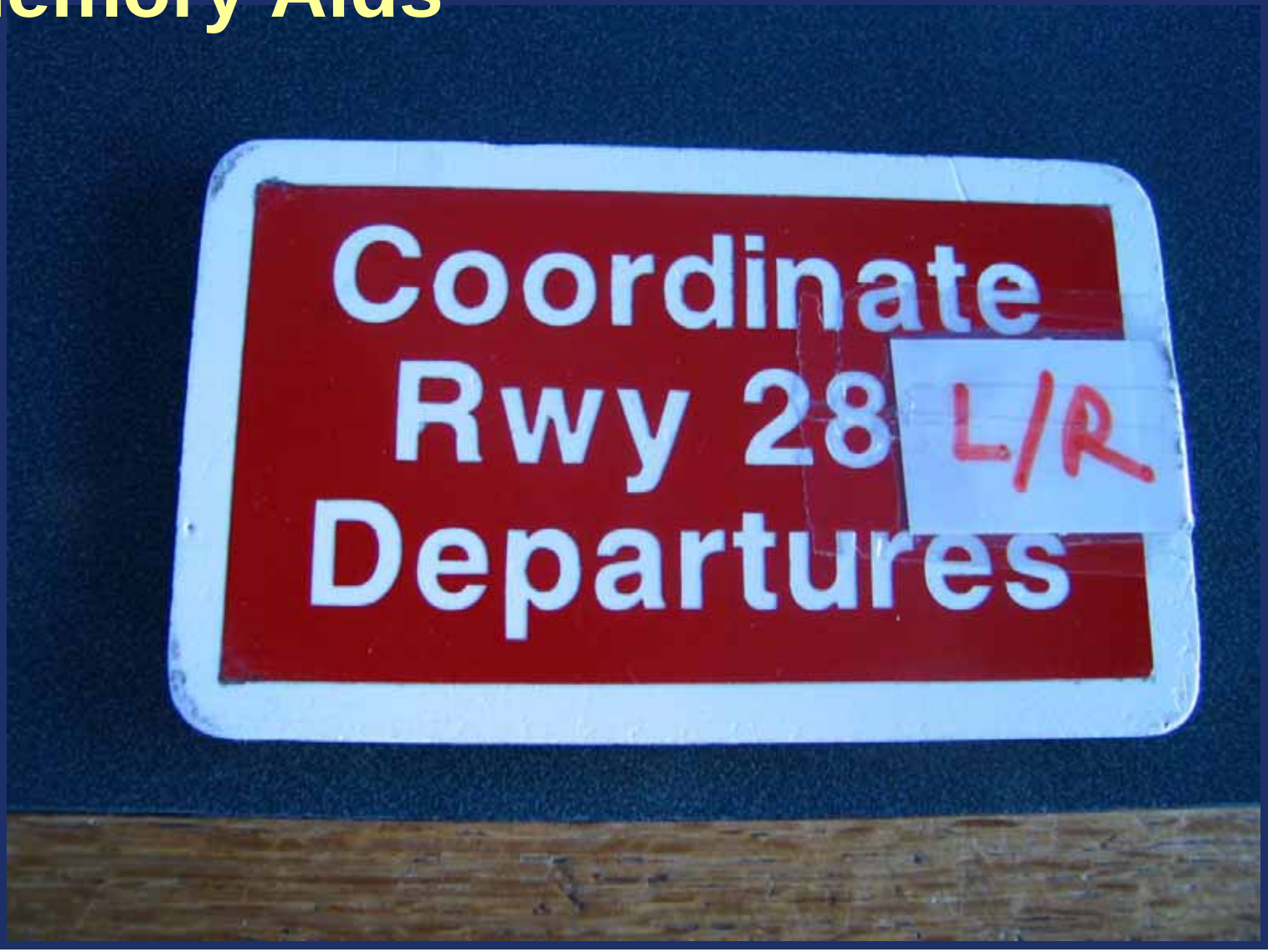
Runway Visual Range (RVR)

Memory Aids

- **Memory aids are devices placed at strategic points in the work area to remind controllers of critical information.**
- **Each ATCT develops memory aids that best suit the operation.**
- **SFO uses strip holders, placards or a combination of the two.**

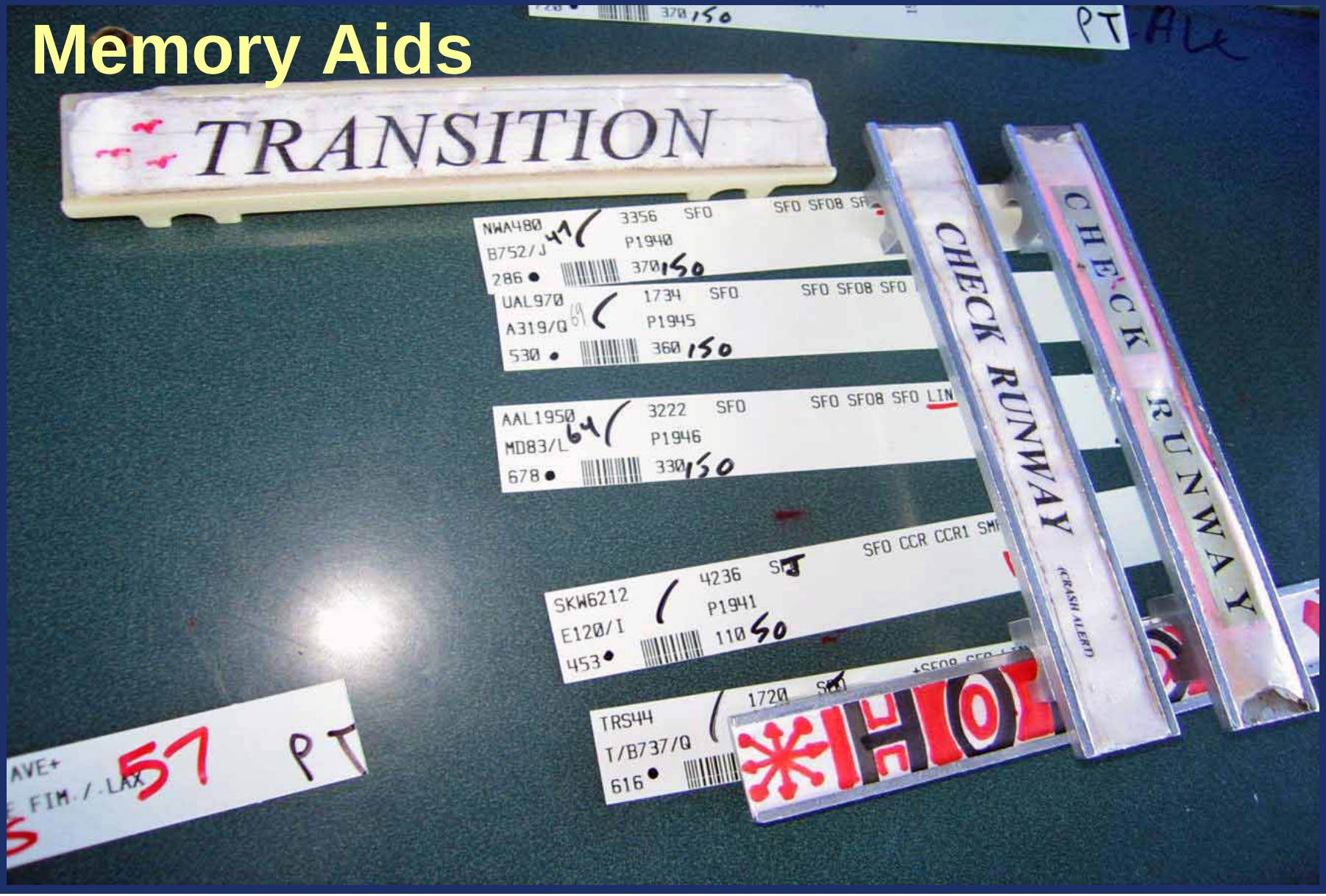
Memory Aids

Memory Aids



Memory Aids

Memory Aids


TRANSITION
CHECK RUNWAY
CHECK RUNWAY
(CRASH ALERT)
NWA480 3356 SFO SFO SFO8
B752/J P1940
286 370 150
UAL970 1734 SFO SFO SFO8 SFO
A319/Q P1945
530 360 150
AAL1950 3222 SFO SFO SFO8 SFO
MD83/L P1946
678 330 150
SKW6212 4236
E120/I P1941
453 110 50
SFO CCR CCR1
TRS44 1720
T/B737/Q
616
AVE+
FIM./LAX 57 PT

Memory Aids

Time Stamp

- Used to denote time of departure
- LC and GC time stamps used to determine length of departure delays

Memory Aids: Time Stamp

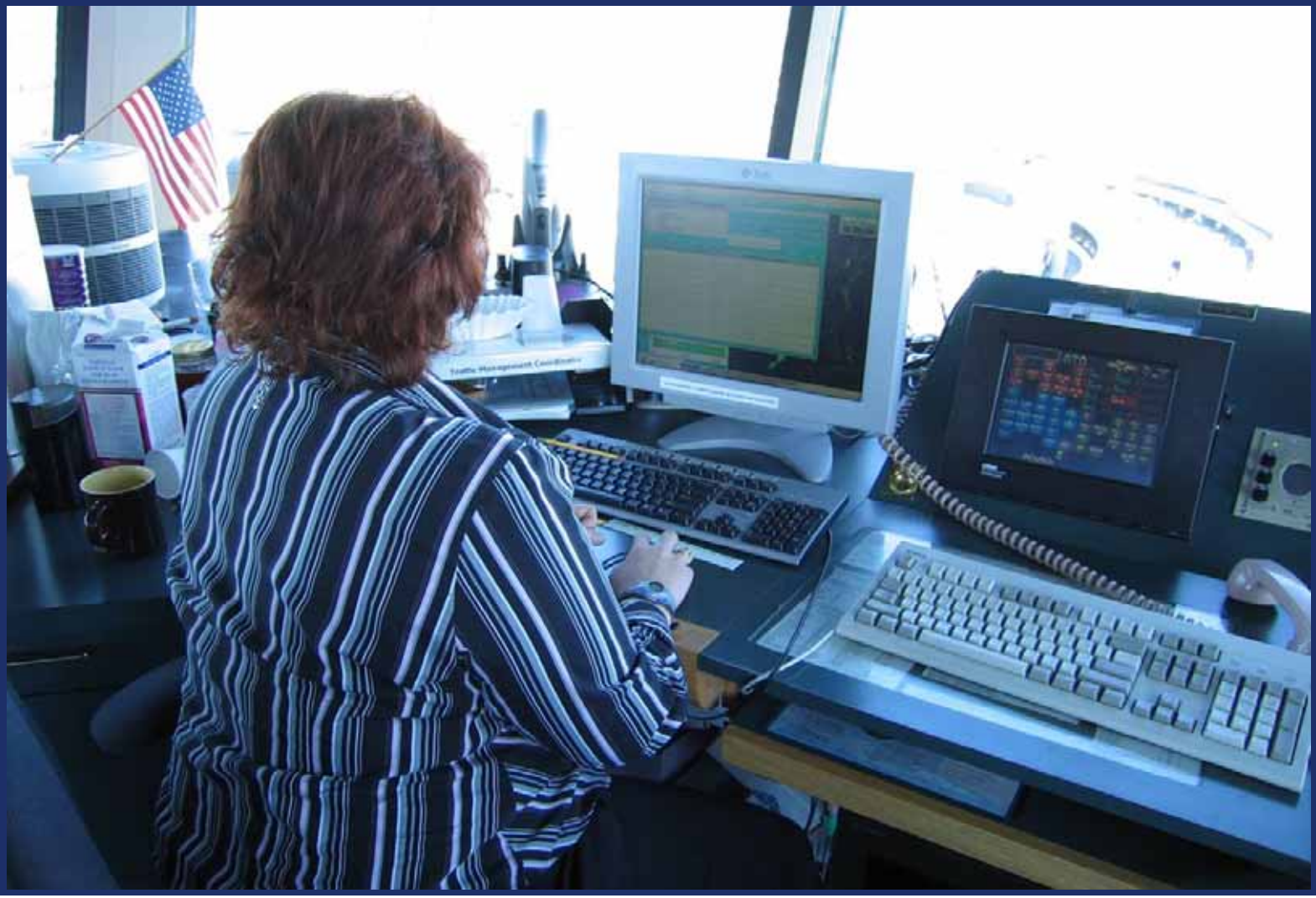
Cab Coordinator

Cab Coordinator

Responsibilities

- Know SOP/LOA
- Watch entire operation for abnormalities and/or errors
- Perform required coordination between GC and LC

Traffic Management Coordinator (TMC)



Traffic Management Mission

The Traffic Management System mission is to balance air traffic demand with system capacity to ensure the maximum efficient utilization of the National Airspace System.

Traffic Management Coordinator (TMC)

SFO ATCT TMC responsible for:

- **Knowing SOP/LOA**
- **Ensuring SFO departures meet flow times:**
  - Call For Release (CFR)
  - Expect Departure Clearance Time (EDCT), domestic and International
- **Securing flow times based on real-time analysis of SFO operations.**
- **Ensuring correct routes are issued to aircraft destined for route-sensitive destinations.**

Traffic Management Coordinator (TMC)

SFO ATCT TMC responsible for:

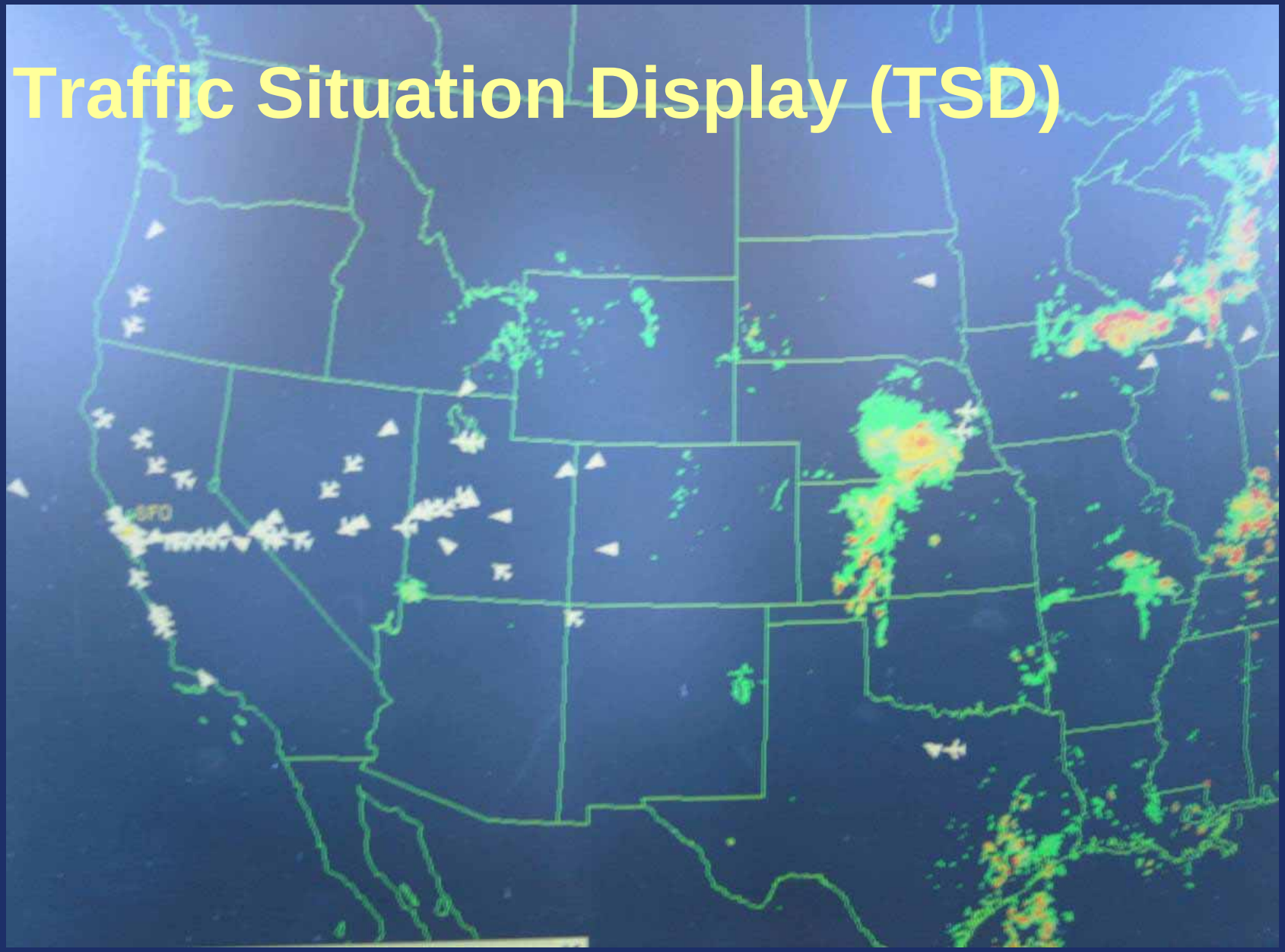
- **Analyzing departure vs. arrival demand; real-time coordination with NCT to assist airport flow.**
- **Coordinating with ATCSCC, ZOA and NCT on the implementation of Traffic Management Initiatives.**
- **Accurate reporting of departure delays**
- **Hourly, daily and monthly traffic counts**
- **Recording SFO TM activities in the National Traffic Management Log**

Traffic Management Coordinator (TMC)

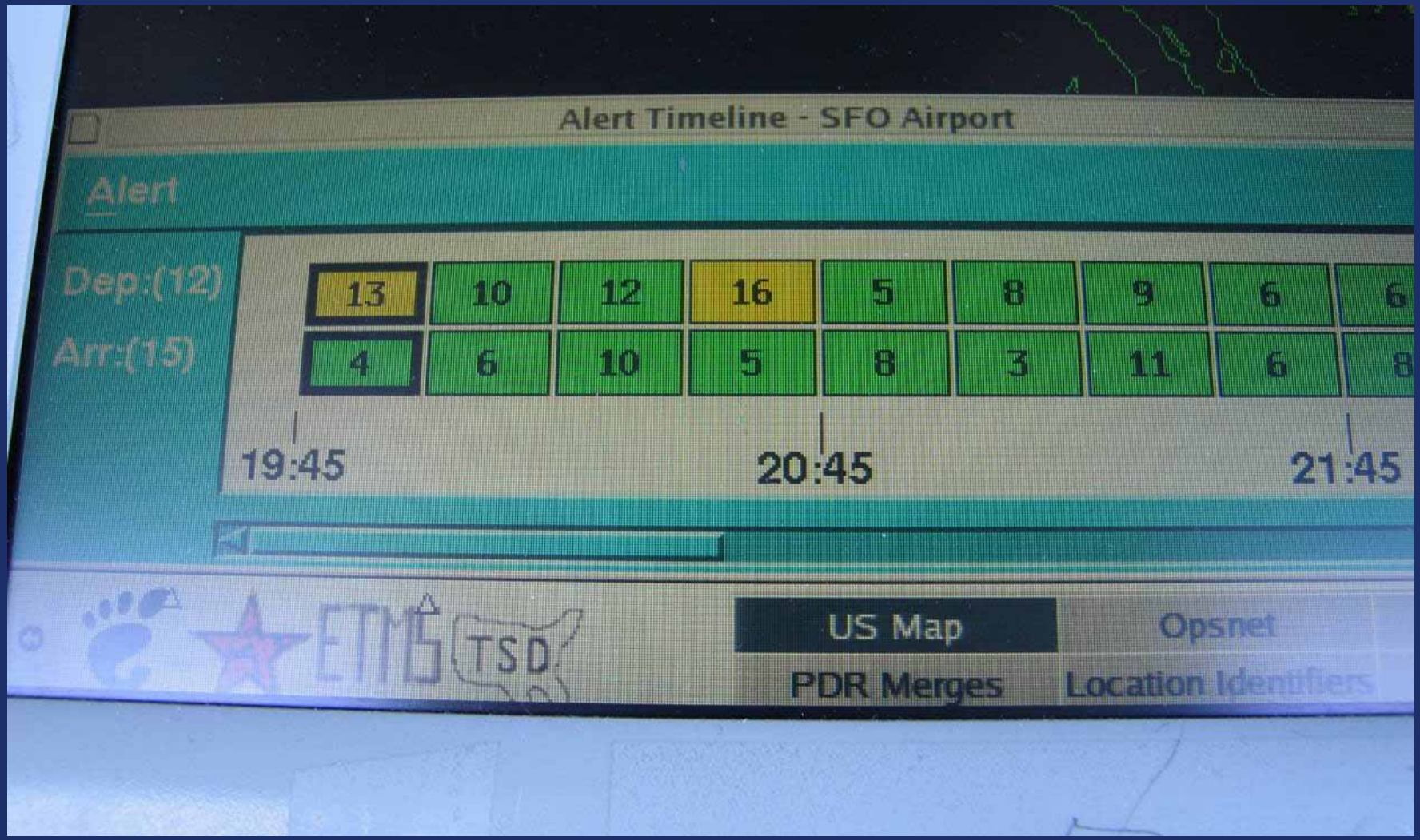
TMC uses the following equipment:

- **Enhanced Traffic Management System (ETMS) Traffic Situation Display (TSD)**
- **RACD**
- **RDVS**
- **OPSNET**

Traffic Situation Display (TSD)



Traffic Situation Display (TSD)



Operations Supervisor

Operations Supervisor

Supervisor responsibilities

- **Know SOP/LOA**
- **Running the shift to ensure the safe, orderly and expeditious flow of air traffic.**

1. **Assigns positions of operation**
2. **Assigns and oversees training**
3. **Performs TM functions**

Operations Supervisor

Supervisor responsibilities

4. **Liaison to public, airport, users, law enforcement, etc.**
5. **Maintain daily record of facility operations**
6. **6. Monitor/ensure equipment operation**
7. **Ensuring a “Model Work Environment”**
8. **AND LOTS MORE……**

ATCT Separation Standards

ATCT Separation Standards

Local Control separates aircraft on runways

Basic rule: Only 1 aircraft on the runway!

1. Single runway separation

- **Departure vs. departure**
- **Departure vs. arrival**
- **Arrival vs. arrival**

ATCT Separation Standards

Local Control separates aircraft on runways

2. Crossing runway separation

- **Departure vs. arrival**
- **Departure vs. departure**
- **Arrival vs. arrival**

Wake Turbulence Affects Separation!

ATCT Separation Standards

Aircraft are separated according to their weight class: *(exception: B757)*

- **HEAVY: Aircraft capable of takeoff weights of more than 225,000 pounds max. CTW**
- **LARGE: Aircraft more than 41,000 pounds up to 225,000 pounds max. CTW**
- **SMALL: Aircraft 41,000 pounds or less max CTW**

ATCT Separation Standards

Local control provides the following separation:

3. Initial separation of IFR departures on same route, and arrivals on final approach: 3 NM unless *wake turbulence applies:*

- **Small/large/B757 behind heavy: 5 NM**
- **Small behind B757: 5 NM**
- **Large/heavy/B757 behind B757: 4 NM**
- **Heavy behind heavy: 4 NM**


AAL1077
UAL870
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UAL1152
010 V
003VV
N747ZP
RIGHT

ATCT Separation Standards

Local control provides the following separation:

4. Initial separation of IFR departures on diverging routes

- **"Side-by", using visual separation (N/A side-by w/ 2 heavy/757)**
- **1 NM until courses diverge by at least 15 degrees**

ATCT Separation Standards

Side-by and stagger-by approaches used in "good weather"

- **Approach control (NCT) ensures rules of visual separation are applied**
- **Pilots are responsible for their own separation**
- **Separation minima do not apply**


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Lufthansa
UNITED AIRLINES

ATCT Separation Standards

Local control provides the following separation:

5. Longitudinal separation of arrivals from Transfer of Control point (6 NM) to runway: 3 NM unless wake turbulence applies.

- **Small behind large: 4 NM (3)**
- **Small behind B757: 5 NM (5)**
- **Small behind heavy: 6NM (5)**

ATCT/TRACON/ARTCC Interface

Letters of Agreement (LOA) facilitate procedural and operational cooperation between persons, facilities and organizations.

- **Supplement established operational/procedural instructions.**
- **Define responsibilities and coordination requirements**
- **Establish and standardize operating methods**
- **Delegate responsibility for ATC service (ATCT, TRACON)**

ATCT/TRACON/ARTCC Interface

SFO ATCT has Letters Of Agreement (LOAs) with:

- **NCT**
- **ZOA**
- **OAK/SQL**
- **ALL AT facilities involved in SVFR and Tower Enroutes**
- **Coast Guard**
- **Commercial companies (helo tours, etc.)**
- **Law Enforcement**
- **Airport rescue equipment**

FACILITIES	SUBJECT
1. SFO ATCT AND NCT	Coordination and Control Procedures
2. SFO, SQL, SJC, RHV, PAO, OAK, NUQ, HWD, NGZ, NCT	Bay Area Special VFR Operations
3. SFO ATCT, SFIA	Airport Emergency Service
4. SFO ATCT, SF AFSFO	Digital Voice Recorder System (DVRS) and DVRS Tapes
5. SFO, NCT, OAK, SJC, RHV, HWD, PAO, LVK, NUQ, SQL, & OAK AIFSS & RIU AIFSS	Coordination/Application of Tower Enroute Clearances
6. SFO TOWER, SFO AIRPORT COMMISSION	Emergency Evacuation of Air Traffic Control Tow
7. SFO Airport	NOTAM Authorization

9.	SFO ATCT, SFO AIRPORTS COMMISSION	Loading Ramps and Parking Area Jurisdictional Responsibilities
10.	NCT, NUQ, SFO, OAK, SJC, HWD, SQL, RHV, PAO, LVK, CALIFORNIA SHOCK TRAUMA AIR RESCUE	California Shock Trauma Air Rescue Discrete Call Sign
11.	SFO, OAK	Interfacility Coordination and Control Procedures
12.	NCT, SAC, SMF, NUQ, RHV, PAO, OAK, SJC, LVK, MRY, SQL, SFO, HWD, SNS	Weather Data Coordinated Via the Auto Surface observation System (ASOS) Equipment Information Display (ACE-
13.	SFO ATCT, COAST GUARD SFO ATCT, SF Helicopter Tours	Coded VFR Arrival/Departure Routes Coded VFR Arrival/Departure Routes

SAN FRANCISCO TOWER

14. SFO ATCT, ZOA, LAX, SCT, LAX, NCT, SJC	Management of Westbound PACOTS Oceanic Traffic
15. SFO ATCT, SFIA	Braking Action Reports, Airport Conditions and Airfield Lighting Runway Inspections
16. SFO, NCT, OAK, SJC, HWD, RHV, PAO, LVK, NUQ, SQL, Rocky Mountain Helicopters	Rocky Mountain Helicopter, LLC Discrete Call Sign
17. ZOA, NCT, SFO, OAK, SJC	Traffic Management Coordination & Control Procedures
18. SFO, SQL	Automated Control Procedures
19. NCT, BAB, CCR, HWD, LVK, MHR, MOD, NUQ, MRY, APC, OAK, PAO, RHV, SAC, SMF, SNS, SQL, SFO, SJC, SCK, STS, HELINET AVIATION Services, LLC	Helinet Aviation Services, LLC, Discrete Call sign

SFO ATCT Operations 2005

- **Total Operations** **365,235**

- **Air Carrier** **241,445**
- **Air Taxi** **89,994**
- **General Aviation** **18,987**
- **Military** **2,445**
- **Overflights** **12,364**

SFO ATCT Operations

Comparison FY 2005 vs. FY 2006 through April:

- **Total Flight Operations: +2.4%**
- **International Flight Operations: +1.9%**
- **Total Airport Passengers: +1.5%**
- **Total International Passengers: +4.4%**
- **Australia/Oceana Passengers: +17.2%**
- **Total Cargo (metric tons): +2.4%**

SFO ATCT 2006

- 28 Air Traffic Controllers
- 2 Traffic Management Coordinators
- 5 Operational Supervisors
- 2 Staff Specialists

SFO ATCT Training

- **Classroom/lecture/written tests**

1. **FD/CD** **20-50 hrs max.**
2. **GC** **8-30 hrs**
3. **RC** **4-8 hrs**
4. **LC** **7-20 hrs**

SFO ATCT Training

- **On-the-job training (OJT)**

1.	FD/CD	70 hours max.
2.	GC	200 hours
3.	RC	70 hours
4.	LC	165 hours

SFO ATCT Training

- **Time to complete training: approx. 3 months to over 1 year**
- **Training time dependant on:**

1. **Experience level**
2. **Skill level**
3. **Availability of training time**
4. **Number of controllers in training**

THANK YOU! QUESTIONS?